Simulation Of A Trash Can Using Line Follower Based On Arduino

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Simulation Of A Trash Can Using Line Follower Based On Arduino

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Abstract: There is a lot of dirt scattered around the State Elementary School (SDN) 03 Purwoyoso, Semarang. The habit of elementary school children and their parents is that they often throw rubbish everywhere and are lazy about throwing away the rubbish. even though there are already rubbish bins provided at the school. Children like new things, especially those shaped like toys. Garbage is a nesting place for bacteria that can cause various diseases. Humans are blessed with five senses which help them detect various things that threaten their lives. However, in the modern world, various forms of threats emerge that are not detected by our five senses, namely various types of poisons made by humans themselves. More than 75,000 synthetic chemicals have been produced by humans in the last decades. Many of them have no color, taste and smell, but have the potential to cause health hazards. Based on the problems described, the author tries to make a trash can using an Arduino-based line follower as a micro controller. This trash can can walk to the desired student line in a certain area with control carried out by a calling mechanism using a recorded voice. And if the smell is strong, the Buzzer will sound, after the students throw away the trash , the Dot Matrix LED will light up the words Thank You. It is hoped that with this rubbish bin, it will make the rubbish bin more attractive so that children will throw rubbish in its place.

Keywords *: Arduino, Buzzer, Line Follower* ***Sensor*** *, Sound Sensor, LED Dot Matrix, Photo Diode Sensor.*

INTRODUCTION

Developments in this era are increasing, humans expect a tool or technology that can help human work, so that technology becomes a necessity for humans.

The waste problem in Indonesia is a complicated problem due to the public's lack of understanding of the consequences caused by waste. The factors that cause the waste problem in Indonesia to become increasingly complicated are the increasing standard of living of the community which is not accompanied by harmony in knowledge about waste and also community participation which lacks maintenance of cleanliness and sanitation . Throw garbage in its place.

A lot of dirt is scattered around the State Elementary School (SDN) 03 Purwoyoso, Semarang. The habit of elementary school children and their parents is that they often throw rubbish everywhere and are lazy about throwing away the rubbish. even though there are already rubbish bins provided at the school . Rubbish It is a breeding ground for bacteria that can cause various diseases .

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However, along with increasingly sophisticated technological developments, the character embedded in society is still quite low. One of them is bad trash throwing habits. Many people throw rubbish everywhere due to various factors, such as the rubbish bin being far from the students' area. Disposing of bad waste results in environmental pollution, disease and flood disasters. The right solution is to give young children an understanding of how to dispose of rubbish in its proper place.

Figure 1.1 Classroom

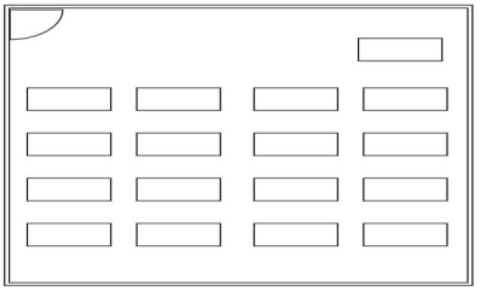


Figure 1.2 Classroom Sketch

Based on the problems that have been explained, the author tries to make a trash can using an Arduino-based line follower as a micro controller. This trash can can walk to the desired student line in a certain area with control carried out by a calling mechanism using a recorded voice. And if the smell is strong, the Buzzer will sound, after the students throw away the trash , the Dot Matrix LED will light up a smile emoticon. It is

hoped that with this rubbish bin, it will make the rubbish bin more attractive so that children will throw rubbish in its place.

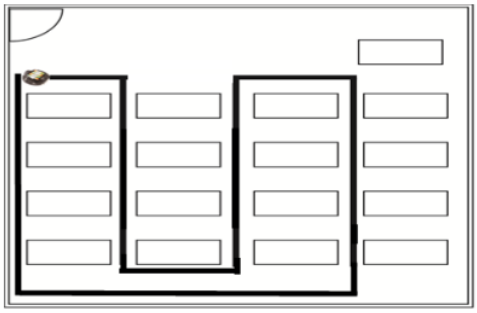


Figure 1.3 Line Follower Sketch

RESEARCH METHODS

1. Simulation

Simulation is a technique of imitating operations or processes that occur in a system with the help of computer devices and is based on certain assumptions so that the system can be studied scientifically. (Law and Kelton, 1991).

In simulation, a computer is used to study the system *numerically* , where data is collected to carry out *statistical estimates* to obtain the original characteristics of the system. Simulation is the right tool to use, especially if you have to carry out *experiments* in order to find the best comments from system components. This is because it is very expensive and takes a long time if *the experiment* is carried out in *real time* . By carrying out a simulation study, the right decision can be made in a short time and the costs are not too large, because everything can be done using a computer. The simulation approach begins with building a real system model. The model must be able to show how the various components in the system interact with each other so that it truly describes the behavior of the system. After the model is created, the model is *transformed* into a computer program so that it can be simulated. Simulation is a methodology for carrying out experiments using a model of a real system (Siagian, 1987).

2. Rubbish

In a broad sense, waste is defined as discarded objects, whether from nature or from technological processes. (Reksosoebroto, 1990)

Garbage is a type of bio mass whose availability from day to day is quite abundant, especially in big cities. Waste is also a concern for many parties, because it is directly related to the cleanliness and beauty (*aesthetics*) of the environment and public health, especially in urban areas. Waste can come from various modes of use, such as something that is no longer used because it is damaged, excess from something used (such as excess food), packaging (packaging) for goods that function to protect goods, leftovers from production activities (such as sawdust, pieces of cloth, wood). or items that are functional and no longer used because the user has newer items. To add value to waste, the potential for using waste can only be explored by creative individuals. One of them is using waste, organic and inorganic, as a living resource.(Hermawati, 2014).

3. Rubbish bin

A trash can is a place to temporarily store waste, which is usually made of metal or plastic. Trash cans are the most important facility in handling existing waste problems. The availability of rubbish bins in optimal locations is one of the determinants of creating a clean environment. Indoors, trash cans are generally kept in the kitchen to dispose of kitchen waste such as fruit peels or bottles. There are also special paper bins used in offices . Some trash cans have a lid on the top to prevent the smell of the trash from escaping. Indoor trash cans are generally lined with bags for easy disposal so there is no need to move the trash can when it is full. Some public places such as parks have rubbish bins placed on the side of the road which can be found *frequently* on the side of the road. This is to avoid the habit of throwing rubbish carelessly which can disturb the beauty and health of the environment as well as social ethics. (Committee on the Waste Isolation Pilot Plant, 2000)

4. Control

Control is the process of setting standards, by receiving feedback in the form of actual performance, and taking necessary action if actual performance differs significantly from what was previously planned . (Hansen and Mowen , 2011)

5. Line Follower Sensor

Line sensors are often used in line follower (line tracking) robots which function to detect black and white line colors. This sensor is usually made from an LED as a light emitter then an LDR or photodiode as a sensor. By utilizing the different light reflecting properties of various colors and applying it to a voltage divider circuit, black and white can be distinguished. The output from the line sensor will be connected to a comparator or directly to a microcontroller that has an ADC feature . (Muhammad Nasir 2012)

Figure 2.1 Line Follower Sensor

(Source: Muhammad Nasir 2012")

6. Stepper Motor

A stepper motor is a type of DC motor that is controlled by digital pulses. The working principle of a stepper motor is to work by converting *electronic pulses into discrete* mechanical movements where the stepper motor moves based on the sequence of pulses given to the stepper motor. What really differentiates a motor or st e pp e r from other types of motor or other types of motor is what is in a motor or A C and motor D C one of them is in terms of their rotation . The st e p m o t o r is a D C m o t or t that does not have a comm u t a t o r .GENERALLY THE MOT OR STEP HAS ONLY HAS A CARE OF PARAGRAPHS ON THE PARTS OF THE STATE OR S AND THE RIGHTAs part of *the* rotary *system* , it is a harvesting m ag n et (fer r o *m* a *g n e t i c material*) .It is because of these str uct ions that the m o t or st e p e r can be t ur p o s i s i n t o t h e p o s i c i o nEither or turn the desired direction , whether in the clockwise direction or the other way around .There are three types of motor or st e pp e r :

m o t o r s t e p p e r *Mag n et* P er m a n e n t , V a r i a b l e *R e l u c t an c e n H y b r i d* . All of the mentioned types perform the same basic basic functions , but they have the same basic functions . e r b e d aa n i mportant in some applications .(kilian , 2003)

Figure 2.2 Stepper Motor

7. Voice Recognition Sensor V3

A process of recognizing someone by recognizing that person's voice . *Automatic Speaker recognition* is the use of a machine to recognize a person from spoken phrases. This system can function in two modes, namely recognizing a special person or proving the identity claimed by a person. (Amin Motohar 2017)

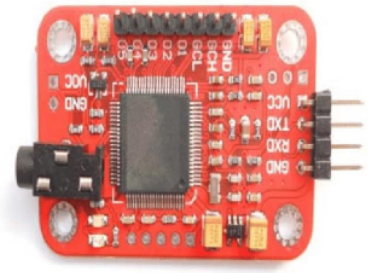


Figure 2.3 Voice Recognition Sensor
(Source: Amin Motohar 2017)

8. HC-SR04 Ultrasonic Distance Sensor

Ultrasonic wave based distance measuring sensor , the working principle of this sensor is similar to *ultrasonic radar* . Ultrasonic waves are emitted and then received back by *the ultrasonic receiver* . The distance between transmit time and receive time is *a representation* of the object's distance. This sensor is suitable for electronic applications that require distance detection, including sensors on robots. The *HC-SR04* sensor is a *low cost version of the PING* ultrasonic sensor made by parallax. The difference lies in the pins used. *HC-SR04* uses 4 pins while *PING* made by Parallax uses 3 pins. On the *HC-SR04 sensor* , the trigger and output pins are placed separately.

Meanwhile, if you use *PING* from Parallax, the *trigger pin* and output are set *by default* to one line. There is no significant difference in implementation. The distance range of the sensor is further than *the PING* made by Parllax, where the PING made by Parllax only has a maximum range of 350 cm, while the *HC-SR04 sensor* has a maximum range of 400-500 cm.

Specifications:

a. Detection range: 2cm to 400 -500cm range
b. The best detection angle is 15 degrees
c. Working voltage 5V DC
d. 1cm resolution
e. Ultrasonic Frequency 40 kHz
f. Can be connected directly to the microcontroller leg. (Subandi 2009)

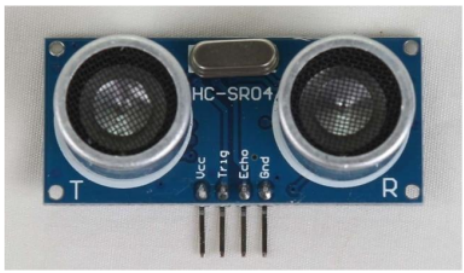


Figure 2.4 Ultrasonic Sensor
(Source: Subandi 2009)

9. Photo Diode Sensor

Photo diode is a type of diode with *resistance* will change when exposed to light rays sent by the "LED" transmitter. The resistance of a photo diode is influenced by *the intensity* of light it receives, the more light it receives, the smaller *the resistance* of the photo diode and vice versa, if the less *intensity* of light received by the photo diode sensor, the greater the *resistance value* (Bilshop, "Basics Electronics", trans. Irzam Harmein, 2004: 32,). Photo diode sensors are the same as LDR sensors, changing the amount of light received by the sensor into changes in *conductance* (the ability of an object to conduct electric current from a material). As seen in Figure 2.1, this is the physical form of a photo diode sensor.

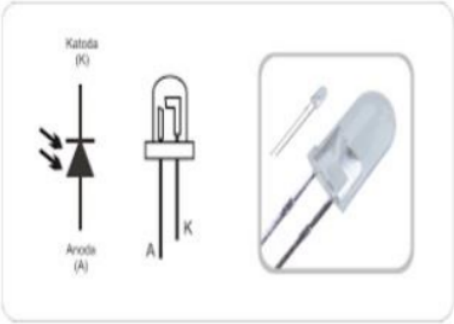


Figure 2.5 Symbols and physical form for photo diodes (Source: Elektronka-dasar.web.id "Photodiode Sensor". 2012)

Photo diodes are made from *semiconductor materials* . Photo diodes that are often used in electronic circuits are photo diodes made from *silicon* (Si) or *gallium arsenide* (GaAs), and others including *indium antimonide* (InSb), *indium arsenide* (InAs), *lead selenide* (PbSe), and *lead sulfide* (PBS). These materials absorb light through their range characteristics. Wavelengths, for example: 250 nm - 1100 nm for photo diodes made of *silicon* , and 800 nm to 2.0 µm for photo diodes made of gas. The specifications for the photo diode are as follows : 1. There are 2 leg pins for the photo diode, namely the anode pin and the cathode pin. 2. The photo diode works in *reverse bias* . 3. The maximum *reverse voltage* photo diode is 32 volts. 2.1.2 Working Principle of the Photodiode Sensor

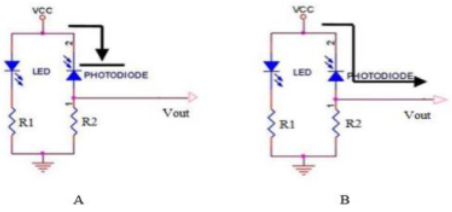


Figure 2.6 Working principle circuit of a photo diode sensor (Source: Elektronka-dasar.web.id "Photo diode sensor". 2012)

As seen in Figure 2.6A, this is the basic circuit of a photo diode sensor. In the initial condition, the LED as a *transmitter* , light will shine on the photo diode as *a receiver so that the resistance* value on the photo diode sensor will be minimum, in other words the V out value will approach logic 0 (low). . Meanwhile, in the second condition in Figure 2.6 B, the light on the LED is blocked by a black surface so that the photo diode cannot receive light from the LED, so the *resistance value* R1 is maximum, so the V out value will approach Vcc which is logic 1 (high). The calculation formula for calculating the value of the V out of the photo diode or for calculating the *resistance value* of the photo diode is:

Equation 1 Calculate the *resistance value* of the photo diode

$$Vout = \frac{Rp\ h\ otodioda}{Rp\ h\ otodioda + \mathrm{R2}} x\ Vin$$

Information: Vin = input voltage to the photo diode sensor circuit Vout = output voltage to the photo diode sensor circuit *R* photo diode = *resistance* of the photo diode R2 = *resistance of* the resistor in the photo diode sensor circuit.

The application of the photo diode sensor circuit that was previously explained can be seen in Figures 2.3A and 2.3B.

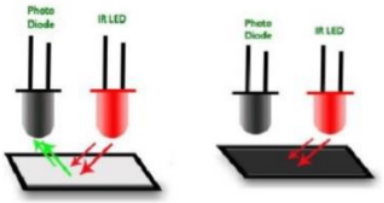


Figure 2.7 Application of photo diode sensors (Source: Elektronka-dasar.web.id "Photo diode sensors". 2012)

Figures 2.7A and 2.7B are photo diode designs to provide output to the photo diode so that it has a low logic or a high logic caused by the color of the surface whose function is to reflect light from the LED as *a transmitter* . In figure 2.7A the photo diode is installed side by side between the photo diode (*receiver*) and the LED (*transmitter*). White paper is placed in front of the photo diode and LED so that the light emitted from the LED will be reflected by the paper and the light will be

received by the photo diode so that the output from the photo diode is logic 0 (low). And in Figure 2.7B, the photo diode and LED are placed side by side and black paper is placed in front of them so that the light emitted by the LED will be absorbed by the black paper so that the photo diode cannot receive light. And that causes the output of the photo diode to be logic 1 (high). (Bilshop, Basics of Electronics", trans. Irzam Harmein, 2004)

10. MQ7 sensors

Sensors used to detect LPG gas, *I-butane*, *propane*, *methane* , alcohol, *hydrogen* and smoke . According to the data *sheet* , the core of MQ 2 is a material that is sensitive to gas concentrations which is composed of the Sn02 compound or in terms we call it Tin (IV) Oxide. This material has the characteristic that *its conductivity* will change along with the concentration of the surrounding gas.

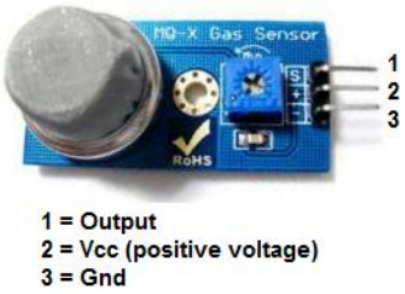


Figure 2.8 MQ7 sensor

(Source: Heri Andriyanto: 2016)

MQ2 Sensor Specifications are as follows:

Working voltage (vcc): 5 V

environment :

- Temperature: 20 C+2 C
- Air humidity : 65% + 5%

Range of gas concentrations that can be measured:

- LPG and propane: 200ppm-5000ppm
- Butane: 300ppm-5000ppm
- Methane: 5000ppm-20000ppm
- Hydrogen: 300ppm-5000ppm
- Alcohol: 100ppm-2000ppm (Sapta Ajie 2016)

RESEARCH METHODS

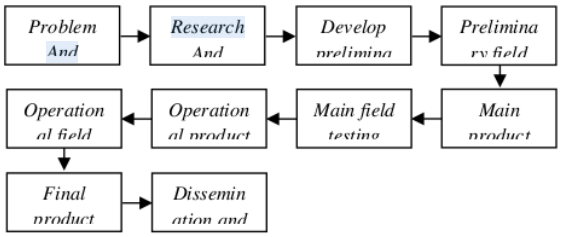
The author's steps in building a Trash Can Simulation Tool Using an Arduino-Based Line Follower use the R & D or *Research and Development method* .

Borg and Gall (1983) define research and development. *Research and Development* is a research method used to produce certain products, and test the effectiveness of these products.

The steps of this process are usually referred to as a cycle R&D, which consists of studying research findings related to the product to be developed, developing the product based on these findings, subjecting it to testing in the setting where it will ultimately be used, and revising it to correct deficiencies discovered in the testing stage. In a program that is stricter than R & D, the cycle is repeated until the test data fields indicate that the product meets the defined behavioral objectives.

The research and development approach is a process used to develop and validate educational products. The research and development approach is often called *Research Based Development* . Research and development is different from development research (*Development Research*).

The following is an explanation of the research and development steps according to Borg and Gall:



Borg & Gall's R&D steps

(Source: Sugiyono, 2008)

The system block diagram is one of the most important parts in designing a device, because from the circuit diagram block you can see how the entire circuit works. So that the entire block diagram of the circuit will produce a system that can function or work according to design. The circuit block diagram of " Trash Can Simulation Using an Arduino Based Line Follower (Case Study of SDN 03 Purwoyoso, Semarang) " can be seen in Figure

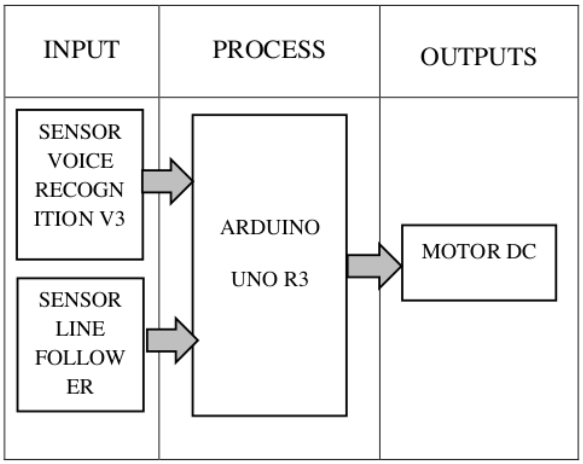


Figure 3.3 Block Diagram of the Tool

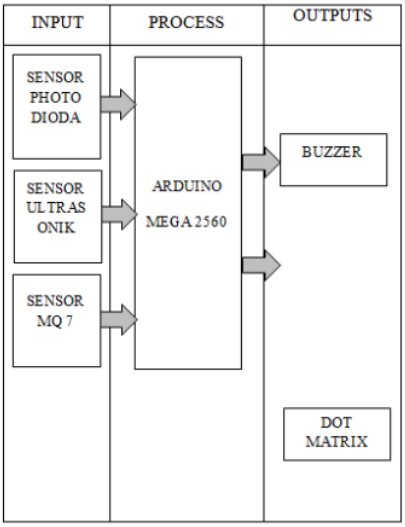


Figure 3.4 Block Diagram of the Tool

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a. Lam Flowchat Diagram a

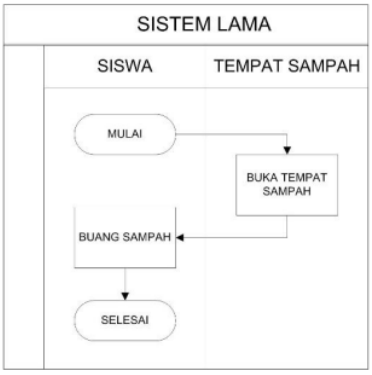

Figure 3.5 Old System Flochart Diagram

b. New Flowchat Diagram

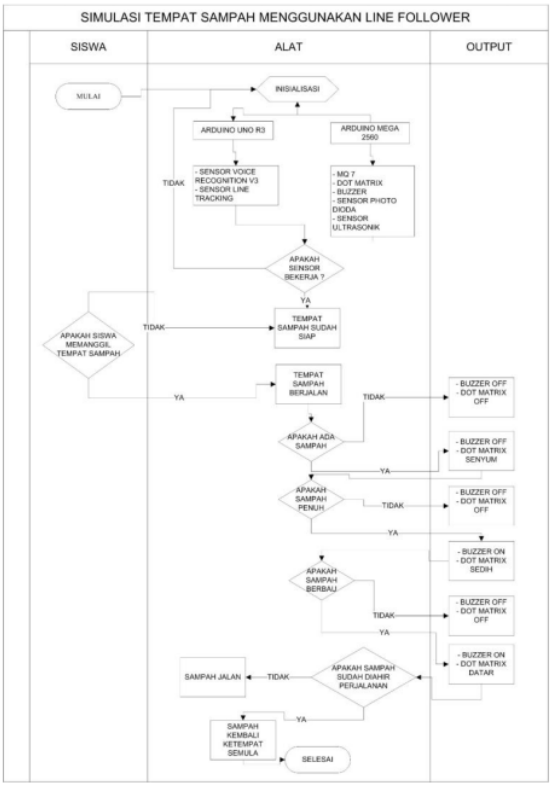

Figure 3.6 New system diagram flowchart

c. Trash Can Simulation Tool Circuit Schematic Using LineFollower

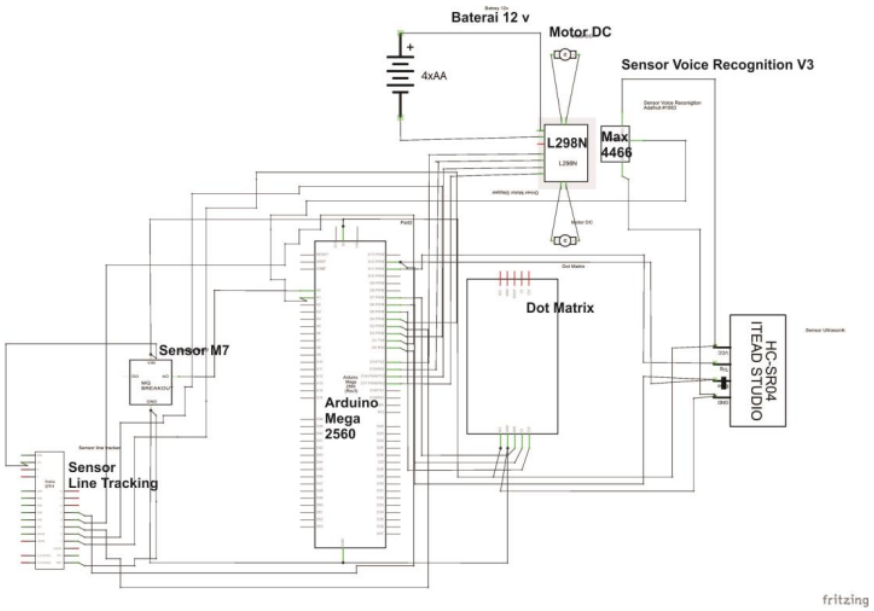

Figure 3.7 Schematic of a Trash Can Simulation Tool Circuit Using a Line Follower

DISCUSSION RESULT

Based on the results of research and findings at SDN 03 Purwoyoso, Semarang , the classrooms in that place do not yet have trash cans that students can walk to to throw the trash in their place, so students are lazy about throwing away the trash , which causes a lot of rubbish to be scattered in the classroom, so the classroom become dirty and also cause health problems for students at school or local residents . The officers will clean the classrooms when the students come home from school so that during class time the scattered rubbish cannot be cleaned up. Therefore, the classrooms at SDN 03 Purwoyoso, Semarang need trash cans that can be within reach of students to dispose of trash in their place and work automatically so that it can make the work of staff at SDN 03 Purwoyoso, Semarang easier.

The author conducted research aimed at creating a technology-based trash can that can move closer to students to increase students ' interest in throwing away trash in its

place, therefore the author wants to provide a solution. The solution that the author will provide is "Trash Can Simulation Using an Arduino-Based Line Follower". The tools that support this research are Arduino Mega 2560, MQ-7 Sensor, Line Tracking Sensor, Ultrasonic Sensor, *Voice Recognition Sensor* , Photo Diode Sensor, LED Dot Matrix, DC Motor, Motor Driver. The working principle is that when the tool is first activated, the process of installing all the sensors, when the sensors are ready, just make a voice call that has been recorded and then the tool will run along the path that has been created. Then, when the trash is put in, *a smile emoticon* notification will appear on the dot matrix, when the trash is full, a notification will appear on the dot matrix and the buzzer will sound and when the trash smells, a notification will appear on the dot matrix and the buzzer will sound. From the explanation above, the difference between the old system is that students who dispose of rubbish must go to the place.

Figure 4.9 Trash can when walking

The image above shows the trash can walking along a predetermined line when the trash can has been called using a recorded voice .

Recorded sound input test table

No	Voice Command Input Type	Number of Tests	Number of Summons	System Success Value (%)
1.	Proceed	10	1	90
2.	Next	10	2	100
3.	Stop	10	1	100

Amount	30	4	290
Average	3		96

After testing all voice commands, the results showed that the trash can simulation using an Arduino-based line follower using the *voice recognition v3 sensor* could function well. This refers to the average success percentage value of the tool being 96%.

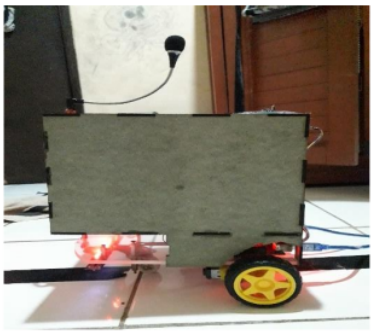

Figure 4.10 When the rubbish comes in, the rubbish is full and the rubbish smells.

The picture above shows the trash can when the trash is put in, when the trash can is full and when the trash can detects smelly trash.

Table 4.9 Trash can testing

No	Trash Can Input Testing	Number of Tests	Sensor Reading Time (Second)	Success Value (%)
1.	When rubbish comes in	10	1	100
2.	When the trash is full	10	3	100
3.	When the trash smells	10	4	90
Amount		30	8	290
Average		3		96

After testing the trash can, the results showed that the trash can simulation uses an Arduino-based line follower using a Photo Diode Sensor to detect when the trash goes in. Dot Matric will display an output in the form of a smile *emoticon* , an Ultrasonic Sensor to detect when the trash is full. Dot Matric will display an output in the form of a sad *emoticon*. and

turn on the buzzer sound, the Mq7 sensor to detect when the trash smells Dot Matric will display an output in the form of a flat *emoticon* and turn on the buzzer sound. The trash can functions well, this refers to the average success percentage value of the tool of 96%.

CONCLUSION

The research that the author made is about Trash Can Simulation Using an Arduino-based line follower and, in accordance with the research objectives of implementing the technology-based trash can in Figure 4.10, with this innovative trash can, it is believed that it can change the habits of students who usually throw rubbish carelessly in the classroom to orderly dispose of rubbish. .

In making the new tool, it was concluded that there was a match between the problem and the solution. The author has built a trash can that can walk along lines. This is proven based on the results of validation carried out on design experts and material experts which produce numbers that determine the results of the new system, namely validation on design experts and material experts produces a value of 2 1 which means "Good".

SUGGESTION

From the conclusions above and the system that has been created, several suggestions can be put forward for consideration for further development, namely as follows:

1. Of the tools that have been designed there are still shortcomings in them. then it can be developed by adding a system that can provide information via smartphone or gadget.
2. Can add a tool that can pick up its own trash.

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